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Standard Practices for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerances[1]

This standard is issued under the fixed designation D4543; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Editorially corrected 5.1 in April 2017.

1. Scope*

1.1 These practices specify procedures for laboratory rock core test specimen preparation of rock core from drill core and block samples for strength and deformation testing and for determining the conformance of the test specimen dimensions with tolerances established by this practice. Cubical, rectangular, or other shapes are not covered by this practice. However, some of the information contained with in this practice and in standard Test Method C170 may still be of use to preparing other test specimen shapes.

1.2 Rock is a complex engineering material that can vary greatly as a function of lithology, stress history, weathering, moisture content and chemistry, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens that satisfy the desirable tolerances given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant or weak (or both) structural features. For these and other rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a specimen in accordance with this practice and for the intended test procedure. However, when it has been determined by trial that this is not possible, prepare the rock specimen to the closest tolerances practicable and consider this to be the best effort (Note 1) and report it as such and if allowable or necessary for the intended test, capping the ends of the specimen as discussed in this practice is permitted.

NOTE 1—Best effort in surface preparation refers to the use of a well-maintained surface grinder, lathe or lapping machine by an experienced operator in which a reasonable number of attempts has been made to meet the tolerances required in this procedure.

1.3 This practices covers some, but not all of the curatorial issues that should be implemented. For curatorial issues that should be followed before and during specimen preparation refer to Practices D5079 and to the specific test standards in 2.1 for which the specimens are being prepared.

1.4 This practice also prescribes tolerance checks on the length-to-diameter ratio, straightness of the elements on the cylindrical surface, the flatness of the end bearing surfaces, and the perpendicularity of the end surfaces with the axis of the core.

1.5 The requirement for specifying the moisture condition of the test specimen is also stated. However, the requirements in the specific test standards in 2.1 should be followed too.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

1.6.1 The practices/procedures used to specify how data are collected/recorded and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design.

1.7 *Units*—The dimensional values stated in either inch-pound units or SI units are to be regarded as standard, such as 4 to 12 in. or 100 to 300 mm. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. (Note, when mass measurements are added to determine densities or unit weights, add the following.)

1.7.1 Only the SI units are used for mass determinations, calculations and reported results. However, the use of balances or scales recording pounds of mass (lbm) shall not be regarded as nonconformance with this standard.

[1] These practices are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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***A Summary of Changes section appears at the end of this standard**

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.9 *These practices offer a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgement. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C170 Test Method for Compressive Strength of Dimension Stone

C617 Practice for Capping Cylindrical Concrete Specimens

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Exploration

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2936 Test Method for Direct Tensile Strength of Intact Rock Core Specimens (Withdrawn 2017)[3]

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D5079 Practices for Preserving and Transporting Rock Core Samples (Withdrawn 2017)[3]

D6026 Practice for Using Significant Digits in Geotechnical Data

D7012 Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

D7070 Test Methods for Creep of Rock Core Under Constant Stress and Temperature

3. Terminology

3.1 For terminology used in this test method, refer to Terminology D653

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

4. Significance and Use

4.1 The dimensional, shape, and surface tolerances of rock core specimens are important for determining rock properties of intact specimens. This is especially true for strong rocks, greater than 7250 psi (50 MPa). Dimensional and surface tolerance checks are required in the test methods listed in Section 2.1. To simplify test procedures in laboratories, the parts of those procedures that are common to the test methods in Section 2.1 are given in this standard.

4.2 This procedure is applicable to all the standards listed in Section 2.1. However, specimens for Test Method D2936 do not need to be machined or to meet the specified tolerances for flatness and parallelism.

4.3 The moisture condition of the specimen at the time of the sample preparation can have a significant effect upon the strength and deformation characteristics of the rock. Good practice generally dictates that laboratory tests be made upon specimens representative of field conditions. Thus, it follows that the field moisture condition of the specimen should be preserved until the time of the test. In some instances, however, there may be reasons for testing specimens at other moisture contents, from saturation to dry. In any case, the moisture content of the test specimen should be tailored to the problem at hand. Excess moisture will affect the adhesion of resistance strain gages, if used, and the accuracy of their performance. Adhesives used to bond the rock to steel end pieces in the direct tension test will also be affected adversely by excess moisture.

NOTE 2—The quality of the result produced by these practices is dependent upon the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing and sampling. Users of these practices are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

5. Apparatus

5.1 *Support Surface*—A flat test surface which shall not depart from a plane by more than 0.0005 in. (0.013 mm) upon which the cylindrical sides of a rock core test specimen may be rolled and a V-block end of a rock core test specimen, displacement gage assembly, or both, is placed, the tolerance of. Machinist grade, certified, granite blocks are commonly used for support surfaces because they do not dent or rust. However, other materials may be used if they meet the criteria of the procedure. The area of the support surface will depend on the size of specimens to be prepared, however, a 12 in. × 12 in. (300 mm × 300 mm) area will be sufficient for most applications.

5.2 *V-block (conformance tests)*—The V-block shall be machinist quality with all bearing faces surfaces ground flat, smooth to within 0.0005 in. (13 μm) and with a 90° included angle. The V-block shall have some means of securing the specimen firmly in the V-block. The dimensions of the V-block must be such that it does not physically interfere with the displacement gage readings.

5.3 *Displacement Gage Assembly:*

5.3.1 *Dial or Electronic Displacement Gage*—The sensitivity of the displacement gage shall be at least 0.001 in. (0.02 mm) for measurement of cylindrical surfaces. The measurement contact tip of the displacement gage shall be round in shape. A displacement gage readable to 0.0001 in. (0.002 mm) is required for measurements on the end surfaces.

5.3.2 *Dial or Electronic Displacement gage Stand*—A stand with a base and vertically mounted rod with an adjustable gage holder to support the gage on the flat surface at the proper height for the specimen and to take measurements normal to the flat surface. The side of the base can be machined flat so that it may be used as a straight edge for taking measurements as shown in Fig. 1 and described in Section 9.1.

5.4 *Feeler Gage Set*—25 or 26 leaf/blade set; 3 in. long by ½ in. wide, and thicknesses beginning at 0.015 in. and ending at 0.025 in. or 25 or 26 leaf/blade set; 75-76 mm long by 12.7-15 mm wide, and thicknesses beginning at 0.04 mm and ending at 1.00 mm.

5.5 *Surface Grinder*—A manual or automatic machinist's surface grinder equipped with a grinding wheel suited for the specimen, a magnetic flat surface and a special V-block to hold the sample during the grinding process. The apparatus is also equipped to apply appropriate cooling and cutting agents (if needed) at the cutting surface to cool the grinding wheel surface and wash away cuttings.

5.6 *V-Block (Grinder)*—A metal V-block for holding the rock specimen in the surface grinder on the magnetic chuck and is configured so that the specimen can be rotated to grind both ends without interfering with the grinding process.

5.7 *Diamond Saw*—A rock saw equipped with a segmented circular diamond saw blade, with a moveable platform for holding and feeding the sample, perpendicular to the core axis, into the cutting surface of the blade. The moveable platform may be a manual or automatic feed. The apparatus is also equipped to apply appropriate cooling and cutting agents (if needed) at the cutting surface to cool the blade and wash away cuttings.

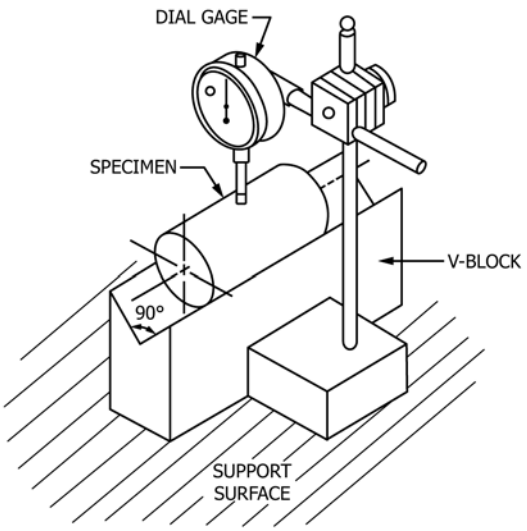

FIG. 1 Assembly for Determining the Straightness of Elements on the Cylindrical Surface (S2)

5.8 *For Drilling Block Samples:*

5.8.1 A 10-horsepower drill, with a GFI (Ground Fault Interrupt) for electrical powered drills.

5.8.2 A thin walled diamond core barrel.

5.8.3 A water swivel and adaptors for hooking up to the drill.

5.9 (Optional) Lapper.

5.10 (Optional) Machinist Shaper.

5.11 Machinist Calipers, or similar device, with vernier, digital, or dial readouts readable to 0.01 in. (0.25 mm) and large enough for the size of the specimens being measured.

5.12 Miscellaneous Tools: machinist scribe and water proof markers.

6. Samples

6.1 Samples for preparing specimens can be either drill cores obtained directly from the in situ rock or obtained from block samples cored in the field or in the laboratory.

6.2 Samples should be selected or obtained (or both) to meet the objectives of the specific standard listed in 2.1 and the test program and any requirements related to anisotropic properties of the in situ material that are relevant to the intended use.

7. Specimens

7.1 Test specimens shall be right circular cylinders within the tolerances specified herein.

7.2 The specimen shall have a length-to-diameter ratio (L/D) of 2.0 to 2.5 and a diameter of not less than 1-⅞ in. (47 mm).

7.2.1 The larger the internal friction angle of a specimen the more desirable it will be to have larger L/D ratios so that the specimen can potentially develop a true shear plane that does not pass through either end of the specimen or is not altered by the specimen size.

NOTE 3—It is desirable that the diameter of rock test specimens be at least ten times the diameter of the largest mineral grain. For weak rock types which behave more like soil (for example, weakly cemented sandstone), the specimen diameter should be at least six times the maximum particle diameter. It is considered that the specified minimum specimen diameter of approximately 1-⅞ in. (47 mm) will satisfy this criterion in the majority of cases. When cores of diameter smaller than the specified minimum must be tested because of the unavailability of larger diameter core or prohibitive use of large drilling equipment (as is often the case in the mining industry), costs, or both, and suitable notation of this fact shall be made in the report.

7.3 The cylindrical surfaces of the specimen shall be generally smooth and free of abrupt irregularities, with all the elements straight to within 0.020 in. (0.50 mm) over the full length of the specimen, as determined by 9.1, procedure S1 or S2.